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Sampling and Analysis Plan for Analyses of Hydrologic Properties, Geochemistry, and Radionuclides from Interbed Cores Drilled at the Radioactive Waste Management Complex

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ABSTRACT

This sampling and analysis plan documents the approach for analyzing cored interbed samples in support of the remedial investigation/feasibility study for Operable Unit 7-13/14. The objective of this core-sampling task is to provide data for comparison to parameter values previously used in TETRAD fate and transport modeling. The task also will advance information on the nature and extent of contamination migrating from the Subsurface Disposal Area. The Subsurface Disposal Area is a radioactive waste landfill within the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory. The product of this study will be used to assess parameters used in past modeling to determine if parameter values should be modified for the remedial investigation/feasibility study modeling.

The approach is to use stored core material obtained during the Organic Contamination in the Vadose Zone Project (Operable Unit 7-08) FY 2003 drilling campaign to measure radionuclide concentrations and material properties present in interbeds beneath the Subsurface Disposal Area. Measurements from these samples will be compared to parameters used in the TETRAD model (i.e., hydraulic and geochemical properties) and to simulated migration of radionuclides. Analysis will focus on radionuclides previously identified as contaminants of concern (specifically the mobile radionuclides Tc-99 and I-129, and less mobile Np-237 and isotopes of uranium and plutonium).

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ACRONYMS

ASTM	American Society for Testing and Materials
CFA	Central Facilities Area
DOT	U.S. Department of Transportation
DQO	data quality objective
HDPE	high-density polyethylene
ID	identification
INEEL	Idaho National Engineering and Environmental Laboratory
MCP	management control procedure
OU	operable unit
PRD	program requirements directive
QAPjP	quality assurance project plan
QC	quality control
RWMC	Radioactive Waste Management Complex
SAP	sampling and analysis plan
SDA	Subsurface Disposal Area
WAG	waste area group

Sampling and Analysis Plan for Analyses of Hydrologic Properties, Geochemistry, and Radionuclides from Interbed Cores Drilled at the Radioactive Waste Management Complex

1. INTRODUCTION

This report documents the plan for analysis of core samples taken from monitoring and extraction wells installed in the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL). Analysis will focus on radionuclides previously identified as contaminants of concern (specifically the mobile radionuclides Tc-99 and I-129, and less mobile Np-237 and isotopes of uranium and plutonium). This analysis is produced in support of the remedial investigation and feasibility study for Operable Unit (OU) 7-13/14. These data will be compared to fate and transport model parameters and also will be used to further characterize the nature and extent of contamination resulting from the release and migration of contaminants buried in the Subsurface Disposal Area (SDA), a radioactive waste landfill, within the RWMC.

1.1 Overview

This project will retrieve from storage specific core samples from monitoring and extraction wells and analyze the contents for geochemical properties and concentrations of radioisotopes. The monitoring and extraction wells were installed from October 2002 through March 2003[a] under the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991) and the "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)" (42 USC § 9601 et seq., 1980). Fourteen boreholes were drilled within the RWMC perimeter and core samples taken. The cores were sealed, labeled, and stored in cargo containers, then transferred to the U.S. Geological Survey Core Library at Central Facilities Area (CFA) Building 663.

1.2 Purpose and Scope

This sampling and analysis plan (SAP) documents the approach for analyzing cored interbed samples now in storage. This analysis includes hydrologic properties and geochemical and radiological analyses. This plan has been prepared in accordance with the "National Oil and Hazardous Substances Contingency Plan" (40 CFR 300), guidance from the U.S. Environmental Protection Agency on preparation of SAPs, and in accordance with Management Control Procedure (MCP) -9439, "Preparation for Environmental Sampling Activities at the INEEL." This SAP describes core sampling activities and details the processes and programs that will (1) ensure that data generated are suitable for their intended uses and (2) meet regulatory and other requirements. The *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites* (DOE-ID 2002) is the governing quality assurance project plan (QAPjP) for this sampling effort.

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a. The wells were drilled as part of the responsibility of OU 7-08 for remediation of organic contamination in the vadose zone.

1.3 Objective

The objective of this core-sampling task is to provide data for comparison to parameter values previously used in TETRAD fate and transport modeling for the remedial investigation and baseline risk assessment for OU 7-13/14. This task analyzes well core samples retrieved from storage for the comparison. Interbed core samples will be selected and analyzed for radionuclides, hydrologic properties, and geochemical properties. The product of this study will assist in determining if parameter values should be modified for the remedial investigation/feasibility study modeling. The task also will advance information on the nature and extent of contamination migrating from the Subsurface Disposal Area.

2. SITE BACKGROUND

The INEEL, originally established in 1949 as the National Reactor Testing Station, is a DOE-managed reservation that has historically been devoted to energy research and related activities. The name was changed to the Idaho National Engineering Laboratory in 1974 to reflect the broad scope of engineering activities taking place at various on-Site facilities. In 1997, the name was changed again to the Idaho National Engineering and Environmental Laboratory to be consistent with contemporary emphasis on environmental research.

The INEEL is located in southeastern Idaho and occupies 2,305 km^2 (890 mi^2) in the northeastern region of the Snake River Plain. Regionally, the INEEL is nearest the cities of Idaho Falls and Pocatello and to U.S. Interstate Highways I-15 and I-86. The INEEL Site extends nearly 63 km (39 mi) from north to south, is about 58 km (36 mi) wide in its broadest southern portion, and occupies parts of five southeast Idaho counties. Public highways (i.e., U.S. 20 and 26 and Idaho 22, 28, and 33) within the INEEL boundary and the Experimental Breeder Reactor I, which is a national historic landmark, are accessible without restriction. Otherwise, access to the INEEL is controlled. Neighboring lands are used primarily for farming or grazing, or are in the public domain (e.g., national forests and state-owned land). See Figure 1 for locations of the INEEL and its major facilities.

2.1 Site Description

The RWMC, located in the southwestern quadrant of the INEEL, encompasses a total of 72 ha (177 acres) and is divided into three separate areas by function: the SDA, the Transuranic Storage Area, and the administration and operations area. The original landfill, established in 1952, covered 5.2 ha (13 acres) and was used for shallow land disposal of solid radioactive waste. In 1958, the landfill was expanded to 35.6 ha (88 acres). Relocating the security fence in 1988 to outside the dike surrounding the landfill established the current size of the SDA as 39 ha (97 acres). The Transuranic Storage Area was added to the RWMC in 1970. Located adjacent to the east side of the SDA, the Transuranic Storage Area encompasses 23 ha (58 acres) and is used to store, prepare, and ship retrievable transuranic waste to the Waste Isolation Pilot Plant. The 9-ha (22-acre) administration and operations area at the RWMC includes administrative offices, maintenance buildings, equipment storage, and miscellaneous support facilities. See Figure 2 for a map of the RWMC showing the location of the SDA.

The crescent-shaped Snake River Plain Aquifer underlies the RWMC at an approximate depth of 177 m (580 ft), and flows generally from the northeast to the southwest. The aquifer is bounded on the north and south by the edge of the Snake River Plain, on the west by surface discharge into the Snake River near Twin Falls, Idaho, and on the northeast by the Yellowstone basin. The aquifer consists of a series of water-saturated basalt layers and sediment.

The regional subsurface consists mostly of layered basalt flows with a few comparatively thin layers of sedimentary deposits. Layers of sediment, referred to as interbeds, tend to retard infiltration to the aquifer and are important features in assessing the fate and transport of contaminants. In the 177-m (580-ft) interval from the surface to the aquifer, three major interbeds are of particular importance. Using nomenclature established by the U.S. Geological Survey, these sedimentary layers are referred to as the A-B, B-C, and C-D interbeds.

2.2 Nature and Extent of Contamination

Transuranic and mixed waste, mostly from the Rocky Flats Plant in Colorado, was buried at the SDA through 1970. Mixed waste containing hazardous chemical and radioactive contaminants was

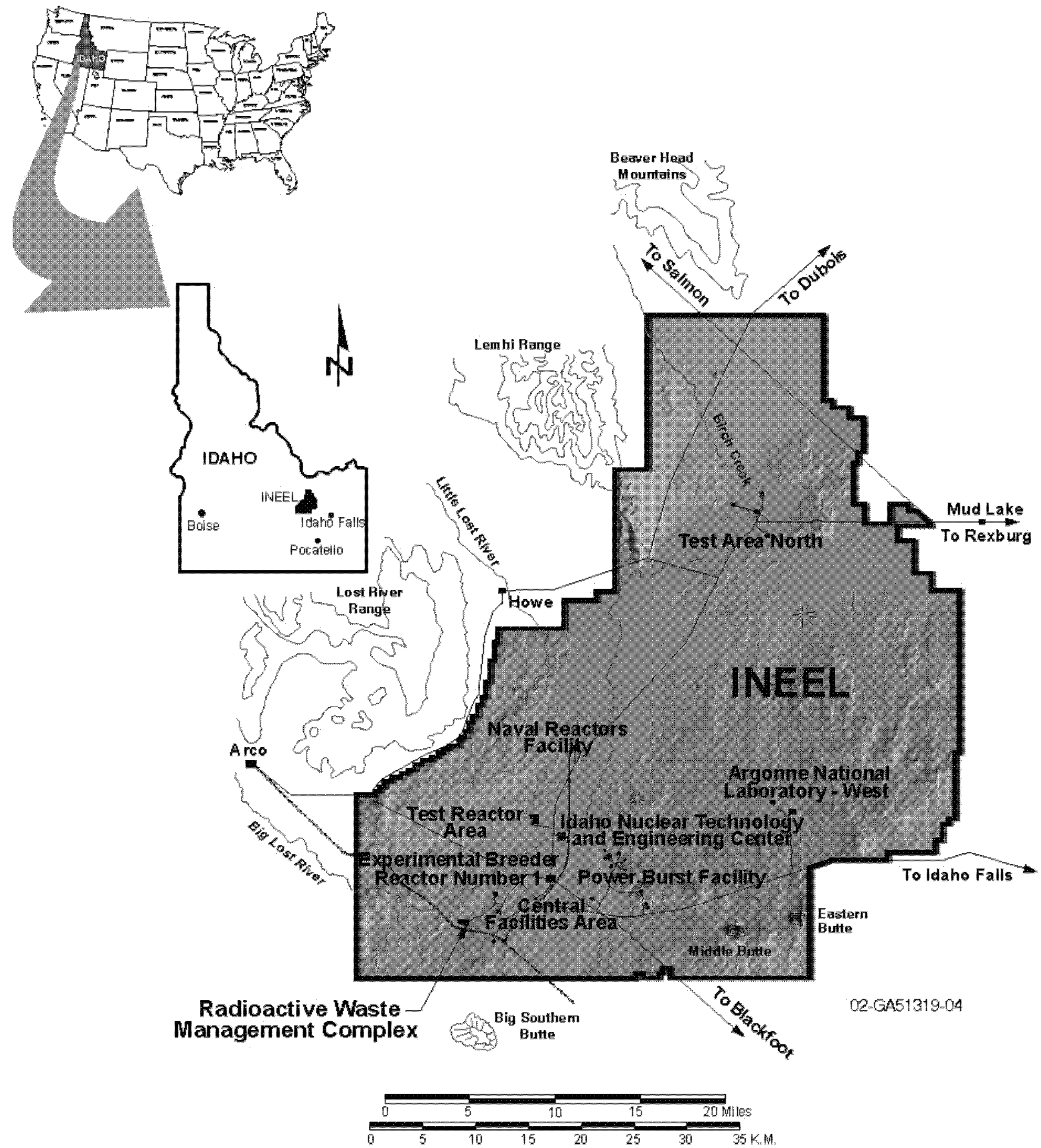

Figure 1. Location of the Radioactive Waste Management Complex and other major facilities at the Idaho National Engineering and Environmental Laboratory.

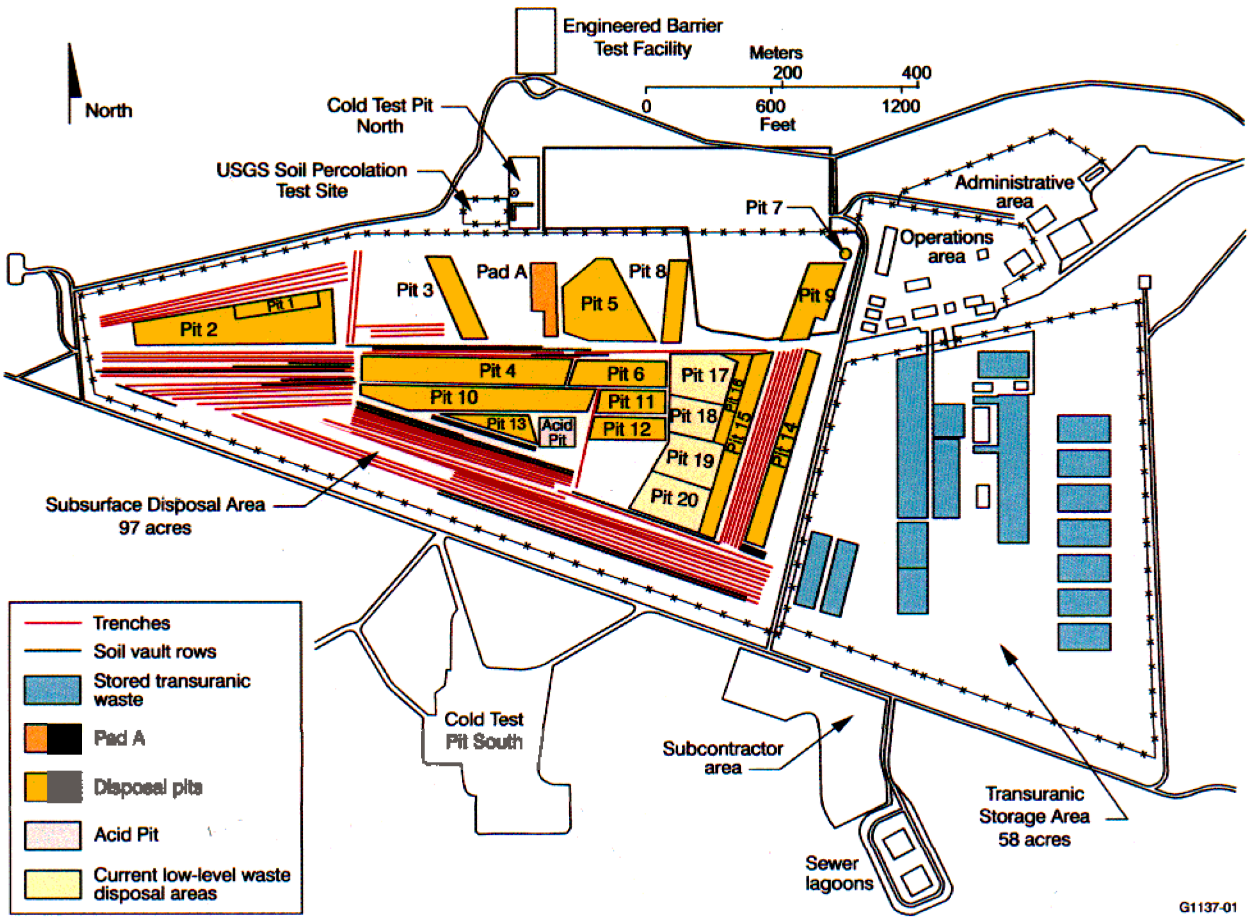

Figure 2. Map of the Radioactive Waste Management Complex showing the location of the Subsurface Disposal Area.

accepted through 1983. Since 1984, waste disposals in the SDA have been limited to low-level radioactive waste from INEEL waste generators. Waste is buried in pits, trenches, and soil vaults. Thus, contaminants in the SDA landfill include transuranic waste resulting from weapons manufacturing at the Rocky Flats Plant, fission and activation products, and other waste resulting from on- and off-Site reactor operations and other sources, and hazardous chemicals associated with all waste sources.

The *Ancillary Basis for Risk Analysis of the Subsurface Disposal Area* (Holdren et al. 2002) presents a comprehensive and detailed evaluation of the nature and extent of contamination. Field monitoring data suggest that C-14, I-129, and Tc-99 are migrating from the buried waste zone (Holdren et al. 2002). Low concentrations of C-14 are affecting the aquifer near the SDA. Iodine-129 and Tc-99 have not affected groundwater quality, but have been detected at low concentrations in the vadose zone and may be migrating. Carbon-14 and Tc-99 are among the most frequently detected contaminants in the vadose zone. Iodine-129 is detected sporadically at concentrations near detection limits.

2.3 Project Description

This project will analyze well core samples retrieved from storage for comparison with parameter values used in the TETRAD fate and transport model for the remedial investigation and baseline risk assessment for OU 7-13/14. Fourteen boreholes were drilled within the RWMC perimeter, from

October 2002 through March 2003 (see footnote a) as either vapor extraction wells or combined monitoring and extraction wells. Of the 14 drilled, five were deep wells.

To obtain the cores of the deep wells, drilling began using the reverse circulation percussion bit; however, once the C-D interbed[b] was encountered, the drilling method switched from the reverse circulation percussion bit to PQ-wireline coring. The entire thickness of the interbed was typically cored, although recovery of the coarser sediments (e.g., sand) was poor. After the C-D interbed was cored, the PQ bit and drill rods were removed and either a 28-cm (11-in.) or 30-cm (13-in.) casing was placed at the top of the interbed and advanced through the interbed to hold out the interbed sediments. The cores were sealed, labeled, and stored in cargo containers, then transferred to the U.S. Geological Survey Core Library at CFA 663.

A total of 32 samples from the five deep extraction wells located within the SDA will be taken mainly from the C-D interbed cores because the B-C interbed was only captured in one core from RWMC-1816 (i.e., Well DE 6). Analysis will focus on radionuclides previously identified as contaminants of concern (specifically the mobile radionuclides Tc-99 and I-129, and less mobile Np-237 and isotopes of uranium and plutonium). Measurements from these samples will be compared to parameters used in the TETRAD model (i.e., hydraulic properties and geochemical properties) and to simulated migration of radionuclides. Core samples from Well DE-6 will provide analyses of the B-C interbed, and cores from the five deep wells will be sampled at the C-D interbed depth. The C-D interbed profiles will be developed from the Well DE-7 and DE-8 cores, if the cores are usable, to document contaminant and hydrologic and geochemical properties through the interbed.

Data collected through analysis of these cores will yield insight into assumptions about contaminant fate and transport and will serve as a comparison for the flow and transport models.

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b. For a full discussion and description of RWMC interbeds, see Anderson and Lewis (1989).

3. SAMPLING OBJECTIVES

The objective of this investigation is to provide an independent assessment of parameters used for fate and transport modeling of contaminants of concern in the SDA. No decisions are based on these data, but results will be used to assess modeling parameters. Hydraulic and geochemical parameters for SDA interbed sediments have been measured at discrete locations and extrapolated to a modeling grid using spatial statistical techniques. Measurements of hydraulic properties and geochemical parameters will be compared to statistical predictions by calculating a relative percent difference to assess transport simulations. Similarly, measured radionuclide concentrations will be compared to the simulation results. No acceptable uncertainty in calculated relative percent difference can be defined before sampling.

There are currently no data from which to assess the variance in these relative percent differences; therefore, no basis is available to calculate decision-error criteria. The results from this investigation will provide that basis should a statistical-based design be identified as a need in the future.

The following sections define data needs and data quality objectives (DQOs) for analysis of the samples.

3.1 Data Needs

Data needs have been determined through evaluation of existing data and projection of data requirements anticipated for confirmation of analytical results obtained during the soil separation process. The data needs, sampling objectives, and measurement approach to meet DQOs for the sampling effort are presented in Table 1. Standard turnaround times are acceptable. Measurement approaches are presented in Table 2.

Table 1. Data quality objectives for analysis of Subsurface Disposal Area cores.

Objective	Approach	Measure
Assess hydraulic parameters used in TETRAD model.	Compare measured parameters to block parameters used in TETRAD model.	Relative percent difference.
Assess geochemical parameters used in TETRAD model (uranium and neptunium only)	Compare K_d calculated from measured parameters to K_d value used in TETRAD model.	Relative percent difference.
Assess TETRAD model radionuclide transport simulations.	Compare measured to simulated radionuclide concentrations.	Relative percent difference.

3.2 Quality Assurance Objectives for Measurement

The quality assurance objectives for measurement will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2002). The QAPjP provides minimum requirements for the following measurement quality indicators: precision, accuracy, representativeness, completeness, and comparability. Precision, accuracy, and completeness will be calculated in accordance with the QAPjP.

Table 2. Core sampling measurement approach for the Subsurface Disposal Area.

Objective	Data Use	Measurement	Method	Detection Level	Number of Samples
Obtain samples from stored interbed cores for hydrologic properties analyses.	Determine spatial variation of the interbed layers underlying the SDA. Support WAG 7 modeling. Provide additional characterization to update and test correlation ranges present in Leecaster (2002) in support of the Ancillary Basis for Risk Analysis (Holdren et al. 2002).	1. Saturated hydraulic conductivity. 2. Porosity 3. Moisture characteristic (seven points) 4. Standard sieves (wet) #4-200/hydrometer analysis 5. Initial volumetric water content 6. Dry bulk density 7. Calculated unsaturated hydraulic conductivity	1. ASTM D2434–68 and *Methods of Soil Analysis* (Chapter 28, Klute 1986) 2. *Methods of Soil Analysis* (Chapter 18) (Klute 1986) 3. ASTM D2325-68 and *Methods of Soil Analysis* (Chapter 26, Klute 1986) 4. ASTM D422-63 5. ASTM D2216-98/D4643-00 (ASTM 2000b) 6. ASTM D2937-00e1 and *Methods of Soil Analysis* (Chapter 13, Klute 1986)	1. $\pm 1 \times 10^{-7}$ cm/s 2. ±0.01 3. ±0.01% 4. ±1 µm 5. NA 6. NA 7. NA	At least one sample in the C-D interbed per well. Up to three samples in three wells, if appropriate, based on observation of core material One sample of the B-C interbed in one well (RWMC-1816 [Well DE-6]), if appropriate, based on observation of core material.
Obtain samples from stored interbed cores for geochemical properties analyses.	Determine spatial variation of geochemical properties of the interbed layers underlying the SDA. Support WAG 7 modeling.	1. X-ray diffraction (quantitative) 2. Clay specific X-ray diffraction 3. Cation exchange capacity 4. Extractable iron, aluminum, and manganese 5. Surface area determination 6. Exchangeable cations	1. *Methods of Soil Analysis* (Part 1, Chapter 12, Sections 3 and 4, Klute 1986) 2. *Methods of Soil Analysis* (Analysis (Part 1, Chapter 12, Sections 3 and 4, Klute 1986) 3. *Methods of Soil Analysis* (Analysis (Part 2, Chapter 8, Klute 1986) 4. *Methods of Soil Analysis* (Analysis (Part 1, Chapter 6, Section 4.3, Klute 1986) 5. ASTM C-1069-86 6. *Methods of Soil Analysis* (Part 2, Chapter 9, Section 3, Klute 1986)	1. NA 2. ±0.1 cmol/kg 3. 1 mg/kg 4. ± 5 m^2/g 5. NA 6. NA	At least one sample in the C-D interbed per well. Up to three samples in three wells, if appropriate, based on observation of core material One sample of the B-C interbed in one well (RWMC-1816 [Well DE-6]), if appropriate, based on observation of core material.
Obtain samples from stored interbed cores for radionuclide analyses.	Assess nature and extent of radionuclide contamination in the vadose zone beneath the SDA. Support WAG 7 modeling.	1. Am-241 2. Plutonium isotopes 3. Uranium isotopes 4. Tc-99 5. I-129 6. Np-237	1. Alpha spectrometry 2. Alpha spectrometry 3. Alpha spectrometry 4. Liquid scintillation counter/gas proportional counter 5. Liquid scintillation counter/gas proportional counter 6. Alpha spectrometry	1. 0.05 pCi/g 2. 0.05 pCi/g 3. 0.05 pCi/g 4. 1 pCi/g 5. 1 pCi/g 6. 0.05 pCi/L	At least one sample in the C-D interbed per well. Up to four samples in three wells, if appropriate, based on observation of core material One sample of the B-C interbed in one well (RWMC-1816 [Well DE-6]), if appropriate, based on observation of core material.

ASTM = American Society for Testing and Materials
NA = not applicable
SDA = Subsurface Disposal Area
WAG = waste area group

3.2.1 Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample-collection procedures and by the natural heterogeneity in soil. Overall precision (field and laboratory) can be evaluated by using duplicate samples collected in the field. Greater precision is typically required for analytes with very low action levels that are close to background concentrations. Evaluation of laboratory precision will be performed during the method-data-validation process.

3.2.2 Accuracy

Accuracy is a measure of bias in a measurement system. Laboratory accuracy is demonstrated using laboratory control samples, blind quality control (QC) samples, and matrix spikes. Evaluation of laboratory accuracy will be performed during the method-data-validation process.

3.2.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data reflect the characteristics being measured.

3.2.4 Detection Limits

Detection limits will meet or exceed the risk-based or decision-based concentrations for the contaminants of concern. Detection limits will be as specified in Sample Analysis Management Laboratory master task agreement statements of work, task order statements of work, and as described in the QAPjP.

3.2.5 Completeness

Completeness is a measure of the quantity of usable data collected during activities. The QAPjP requires that an overall completeness goal of 90% be achieved for noncritical samples. If critical parameters or samples are identified, then a 100% completeness goal is specified. Critical data points are those sample locations or parameters for which valid data must be obtained for the sampling event to be considered complete.

For this project, all laboratory-generated data will be considered critical because these data are required to support the DQOs described in Table 1. The completeness goal for these data is 100%.

3.2.6 Comparability

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sampling designs. If sampling designs are biased, the reasons for selecting another design should be well documented.

For all samples collected for laboratory analyses, comparable sampling techniques and laboratory analytical methods will be used as done for previous sampling actions; therefore, the laboratory-generated data will be comparable to that historically collected.

3.3 Data Validation

Method data validation is the process whereby analytical data are reviewed against set criteria to ensure that the results conform to requirements of the analytical method and any other specified requirements.

Radiological data will be validated to Level B. This level offers a review of the laboratory batch QC to ensure that the laboratory met the contractual agreements and that the data are reasonable. Hydrologic and geochemical data will not require data validation (Level NA).

4. SAMPLING LOCATION AND FREQUENCY

Material presented in this section is intended to support the DQOs summarized in Section 3. The SAP tables for the required sample analyses are presented in Appendix A. The SAP tables will aid in sample labeling and tracking.

4.1 Sampling Locations

Locations for the cored wells in the SDA are shown in Figure 3. Table 3 provides a list of the wells, their location, approximate depths of interbeds, and the core analyses that will be performed.

4.2 Sampling Frequency

As outlined in the DQOs presented in Table 1 and summarized in Table 2, samples will be collected from interbed layers for analyses of radionuclides, hydrologic properties, and geochemical properties. Table 3 discusses the expected number of samples for hydrologic, geochemical, and radionuclide profile analyses. The actual number of samples and their depths will depend on the condition of the cored interbed material observed when the Lexan tubes are opened. Separate samples will be taken for each analysis type.

Figure 3. Cored well locations inside the Subsurface Disposal Area.

Table 3. Locations, depths, and numbers of cores to be sampled.

Well Name	Location	Approximate Depth (available in core material) (ft/bls)	Objectives	Core Analyses
RWMC-1810 (DE-3)	N 669777.67 E 267358.42	240	Nature and extent of radionuclide contamination Hydrologic and geochemical properties determined from core samples.	• One hydrologic properties sample • One radionuclide sample • One geochemical properties sample
RWMC-1813 (DE-4)	N 669490.74 E 266404.27	231–235 235–239 239–242	Nature and extent of radionuclide contamination Hydrologic and geochemical properties determined from core samples.	• Two hydrologic properties samples • Two radionuclide samples • Two geochemical properties samples
RWMC-1816 (DE-6)	N 669276.65 E 266422.67	101–102 240–245	Nature and extent of radionuclide contamination Hydrologic and geochemical properties determined from core samples Contaminant and interbed properties profile through the interbed	• Two hydrologic properties samples [one from the B-C interbed (if core is intact) and one from C-D interbed] • Two radionuclide profile samples (one from B-C and one from C-D interbed) • Two geochemical properties samples (one from B-C and one from C-D interbed)
RWMC-1819 (DE-7)	N 669233.73 E 267021.76	235–239 241–243 243–248 248–251	Nature and extent of radionuclide contamination. Hydrologic and geochemical properties determined from core samples Contaminant and interbed properties profile through the interbed.	• Three hydrologic properties samples • Four radionuclide profile samples • Three geochemical properties samples
RWMC-1822 (DE-8)	N 669451.29 E 267570.51	232–237 237–240.5 240.5–241 241–242.6	Nature and extent of radionuclide contamination Hydrologic and geochemical properties determined from core samples.	• Three hydrologic properties samples • Two radionuclide profiles • Two geochemical properties samples

5. SAMPLING DESIGNATION

5.1 Sample Identification Code

A systematic character identification (ID) code will be used to uniquely identify all samples. Uniqueness is required for maintaining consistency and preventing the same ID code from being assigned to more than one sample.

The first through fourth designators of the code, RWMC, refer to the sample originating from the RWMC. The fifth and sixth designators, 00 through 09, designate the sequential sample number for the project. The seventh and eighth designators identify the analysis type. For example, a core sample collected to determine the radionuclide content might be designated as RWMC00RN, where (from left to right):

- "RWMC" designates the sample as originating from the RWMC
- "01" designates the sequential sample number
- "RN" designates radionuclide analysis.

A SAP table or database will be used to record all pertinent information associated with each sample ID code.

5.2 Sampling and Analysis Plan Table

A SAP table format was developed to simplify presentation of the sampling scheme for project personnel. The following sections describe information recorded in the SAP table or database, which is presented in Appendix A.

5.2.1 Sample Description

The sample description fields contain information relating individual sample characteristics.

5.2.1.1 Sampling Activity. The sampling activity field contains the first six characters of the assigned sample number. The sample number in its entirety will be used to link information from other sources (e.g., field and analytical data) to the information in the SAP table for data reporting, sample tracking, and completeness reporting. The analytical laboratory will also use the sample number to track and report analytical results.

5.2.1.2 Sample Type. Data in this field will be selected from the following:

- REG for a regular sample
- QC for a QC sample.

5.2.1.3 Media. Data in this field will be selected from the following:

- BA for basalt samples
- IB for interbed samples
- WA for water quality assurance and QC samples.

5.2.1.4 *Collection Type.* Data in this field will be selected from the following:

- CORE for core sampling
- RNST for rinsates
- DUP for duplicate samples.

5.2.1.5 *Planned Date.* This date relates to the planned sample collection start date.

5.2.2 Sample Location Fields

This group of fields pinpoints the exact location for the sample in three-dimensional space, starting with the general area, narrowing the focus to an exact location geographically, then specifying the depth in the depth field.

5.2.2.1 *Area.* The AREA field identifies the general sample collection area. This field should contain the standard identifier for the INEEL area being sampled. For this investigation, samples are being collected from the RWMC, and the AREA field identifier will correspond to this site.

5.2.2.2 *Location.* This field may contain geographical coordinates, x-y coordinates, building numbers, or other location-identifying details as well as program-specific information (e.g., a borehole or well number). Data in this field will normally be subordinated to the AREA. For this investigation, the location will indicate the well being drilled. This information is included on the labels generated by the Sample Analysis Management to aid sampling personnel.

5.2.2.3 *Type of Location.* The TYPE OF LOCATION field supplies descriptive information concerning the exact location of the sample. Information in this field may overlap that in the location field, but it is intended to add detail to the location.

5.2.2.4 *Depth.* The DEPTH field for a sample location is the distance in feet from surface level or a range in feet from the surface.

5.2.3 Analysis Types

5.2.3.1 *AT1-AT20.* These fields indicate analysis types (e.g., radiological, chemical, and hydrologic). Space is available at the bottom of the form to clearly identify each type. A standard abbreviation should also be written if possible.

6. SAMPLING PROCEDURES AND EQUIPMENT

The following sections describe the procedures and equipment to be used for the sampling and analyses described in this SAP.

6.1 Sampling Requirements

6.1.1 Core Subsampling for Laboratory Analysis

Core tubes were examined, described as much as possible given the scratched condition of the Lexan tube, and photographed (see Appendix B for photos and description of core inside tubes). The core descriptions were used to determine the core interval of interest for sampling.

At the time of sampling, the sampler will determine the sample interval based on visual inspection of the core using the following prioritized criterion:

1. Top of the core interval, for selected radionuclides of concern, depending on perceived mixing or cross-contamination of core within the Lexan tube
2. Changes in lithology for radiological samples, excluding coarse material
3. Intact core to measure intact hydrologic properties near the top of interbed, if possible
4. Geochemical as similar to hydrologic properties intervals as possible to obtain comparable data.

Hydrologic properties samples require an intact sample approximately 6 in. long. Hydrologic and geochemical samples will be taken from the uppermost section of the core interval (nearest the basalt layer above the interbed) and will be taken from this section of interbed core sample tube sections in profile sample wells (RWMC-1816 [DE-6] and RWMC-1822 [DE-8]). Radiological samples will also be taken from the same sections of core and from a distinct coarse-to-fine (e.g., sand to silt or clay) sediment interface, if available.

The Lexan tube will be cut with a fresh saw blade for each desired interval. Core sample sections will be sealed in the original Lexan tube using caps and tape for shipment to laboratories for analysis. Radiological Control personnel will survey the exposed core for all samples.

Table 4 outlines the specific sample requirements necessary for meeting the DQOs described in Table 1. Holding times for radionuclides are generally contractually limited to 6 months. These samples have exceeded that holding time while stored in the U.S. Geological Survey Core Library facility (CFA 663). The radionuclides of interest are nonvolatile, nondegradable, and have half-lives long relative to the time since sample collection. No impact on analysis results from holding time is expected.

Table 4. Specific sample requirements.

Analytical Parameter	Container		Preservative	Method	Holding Time
	Size	Type			
Hydrologic	Sediment—6 in.	Core sleeve	None	See Table 1	None
Geochemical	Sediment—6 in.	HDPE	None	See Table 1	None
Radionuclides	Sediment—16 oz	HDPE	None	See Table 1	None

HDPE = high-density polyethylene

6.1.2 Personal Protective Equipment

Personal protective equipment required for this sampling effort is limited to gloves for handling cores and containers. Before disposal, gloves will be surveyed by Radiological Control personnel to determine whether they will be disposed of in appropriate containers at the U.S. Geological Survey Core Library facility (CFA 663) or whether a waste stream profile is needed from Waste Generator Services. Determination of appropriate disposal will be made according to the requirements set forth in MCP-62, "Waste Generator Services Low Level Waste Management."

6.1.3 Shipping Screening

Core interbed samples will be surveyed for external contamination and radiation levels. If samples exhibit survey results above background levels, a gamma-screening sample will be collected and submitted to the Radiation Measurement Laboratory located at the Test Reactor Area for a 20-minute analysis before shipment. Gamma-screening analysis can be performed using the same sample as obtained for gamma spectrometric analysis (i.e., Cs-137 for soil samples).

6.2 Handling and Disposition of Investigation-Derived Waste

Investigation-derived waste (generated during the core sampling activities) will be limited to those described herein. The disposition and handling of waste for this project will be consistent with the *Waste Certification Plan for the Environmental Restoration Program* (Jones 1997). Samples will be handled in accordance with MCP-3480, "Environmental Instructions for Facilities, Processes, Materials, and Equipment."

Waste will be generated from the drilling and coring activities conducted during this project. Waste is expected to be nonhazardous and nonradioactive and includes the following:

- Personal protective equipment (limited to gloves)
- Miscellaneous waste (e.g., paper towels and saw blades).

6.2.1 Waste Minimization

Waste minimization techniques will be incorporated into planning and daily work practices to improve worker safety and efficiency. In addition, such techniques will aid in reducing the project environmental and financial liability. Specific waste minimization practices to be implemented during the project will include, but are not limited to, collecting all samples necessary at one time, such that additional waste is not generated from resampling.

The *U.S. Department of Energy Idaho Operations Office Idaho National Engineering and Environmental Laboratory Pollution Prevention Plan* (DOE-ID 1997) addresses efforts to be expended and the reports required to track waste generated by projects. This plan directs that the volume of waste generated by INEEL operations be reduced as much as possible.

6.2.2 Laboratory Samples

All laboratory and sample waste is managed in accordance with the Sample Analysis Management master task agreements, as part of the contract for the subcontracted laboratory. The laboratory will dispose of any unused sample material. Laboratories are responsible for any waste generated by sample analysis. If unused sample material must be returned from the laboratory, only the unused, unaltered samples in the original sample containers will be accepted from the laboratory. These samples will be returned to the core stream from which they originated. If the laboratory must return altered sample material, the laboratory will specifically define the types of chemical additives used in the analytical process and assist in making a hazardous waste determination. This information will be provided to the project team leader. Management of this waste will also require separation from the other unaltered samples being returned.

6.2.3 Sample Containers

Sample containers will become a waste stream in the event that they are no longer usable and disposal is required. Core sampling is anticipated to generate only clean debris.

6.2.4 Miscellaneous Waste

Miscellaneous waste (e.g., trash, labels, paper towels, and other miscellaneous debris) may be generated during the project. Clean miscellaneous waste will be disposed of in appropriate waste containers at the Core Library.

7. DOCUMENTATION MANAGEMENT AND SAMPLE CONTROL

Section 7.1 summarizes document management and sample control. Documentation includes a logbook to record core sampling data, chain-of-custody forms, and sample container labels. Section 7.2 outlines the sample handling and discusses chain-of-custody, radioactivity screening, and sample packaging for shipment to the analytical laboratories. The analytical results from these sampling efforts will be documented in a final report.

7.1 Documentation

The team leader will be responsible for controlling and maintaining all documentation, sampling logbooks and records, and for ensuring that all required documents are submitted to the Environmental Restoration Administrative Records and Document Control Center. All entries will be made in permanent ink. All errors will be corrected by drawing a single line through the error and entering the correct information; all corrections will be initialed and dated.

7.1.1 Sample Container Labels

Waterproof, gummed labels generated from the SAP database will display information such as the sample ID number, the name of the project, sample location, and analysis type. Labels will be completed and placed on the containers before collecting the sample. Information concerning sample date, time, and the sampler's initials will be filled out during sampling.

7.1.2 Field Guidance Forms

Field guidance forms, which are provided for each sample location, will be generated from the SAP database to ensure sample numbers are unique. These forms are used to facilitate sample container documentation and organization of field activities, and they contain information about the following:

- Project title
- Sample Analysis Management point of contact and phone number
- Sample and analysis plan table title
- Statement of work ID (task order statement or statement of work number)
- Laboratory contact information
- Matrix (media)
- Analysis type and line item code
- Sample quantity
- Preservation method
- Container size and type
- Holding time for each analysis type.

7.1.3 Core Sampling and Shipping Logbook

In accordance with Administrative Records and Document Control format, a core-sampling logbook will be used to record information necessary to determine the appropriate core interval to obtain for analysis. The logbook will document the following, if applicable:

- Physical measurements
- Shipping information (e.g., collection dates, shipping dates, cooler ID number, destination, chain-of-custody number, and name of shipper)
- All team activities
- Problems encountered.

This logbook will be signed and dated at the end of sampling activities. The core-sampling logbook will be controlled and managed in accordance with MCP-1194, "Logbook Practices for ER and Deactivation, Decontamination, and Decommissioning Projects."

7.2 Sample Handling and Shipping

All samples will be handled in accordance with MCP-9364, "Handling, Storing, and Shipping Samples." Qualified (i.e., approved by Sampling and Analysis Management) analytical and testing laboratories will be used.

7.2.1 Sample Containers

Analytical samples for laboratory analyses will be collected in Lexan tubes, placed in precleaned bottles, and packaged in accordance with Section 2.3.2.1, "Sample Containers," in the QAPjP.

7.2.2 Chain-of-Custody Procedures

The chain-of-custody procedures will be followed in accordance with the requirements of Program Requirements Directive (PRD) -5030, "Environmental Requirements for Facilities, Processes, Materials, and Equipment"; MCP-3480; MCP-1192, "Chain-of-Custody and Sample Labeling for ER and D&D&D Projects"; and the QAPjP. Sample bottles will be stored in a secured area, which is accessible only to the sampling team members.

7.2.3 Transportation of Samples

Samples will be shipped in accordance with the regulations issued by the U.S. Department of Transportation (DOT) (49 CFR 171 through 178) and U.S. Environmental Protection Agency sample handling, packaging, and shipping methods (40 CFR 261.4[d]). All samples will be packaged in accordance with the requirements set forth in MCP-3480 and PRD-5030.

7.2.3.1 Custody Seals. Custody seals will be placed on all shipping containers in such a way as to ensure that sample integrity is not compromised by tampering or unauthorized opening. Clear-plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment.

7.2.3.2 On- and Off-Site Shipping. An on-Site shipment is any transfer of material within the perimeter of the INEEL. Site-specific requirements for transporting samples within INEEL boundaries and those required by the Shipping and Receiving Department will be followed. Shipment within the INEEL boundaries will conform to DOT requirements (49 CFR). Off-Site sample shipment will be coordinated with Packaging and Transportation Department personnel, as necessary, and will conform to all applicable DOT requirements.

7.3 Document Revision Requests

Revisions to this document will follow MCP-233, "Process for Developing, Releasing, and Distributing ER Documents (Supplemental to MCP-135 and MCP-9395)."

8. REFERENCES

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49 CFR 171, 2003, "General Information, Regulations, and Definitions," *Code of Federal Regulations*, Office of the Federal Register.

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